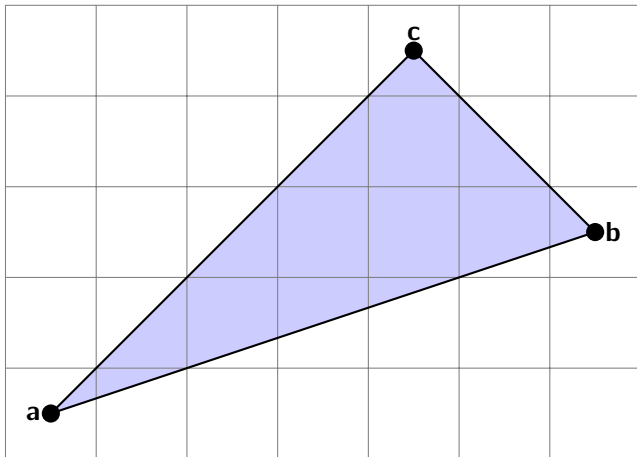


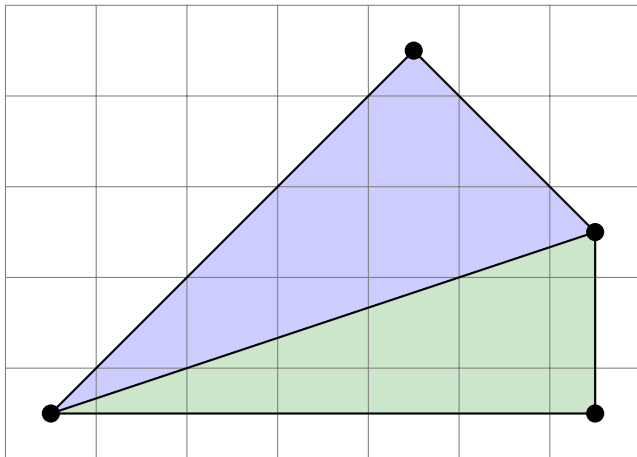
# Triangle Rasterization

University of California Riverside

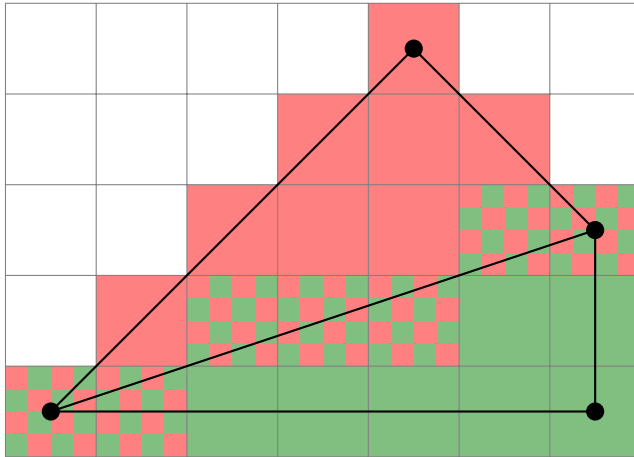
Which pixels?



## Rasterizing adjacent triangles

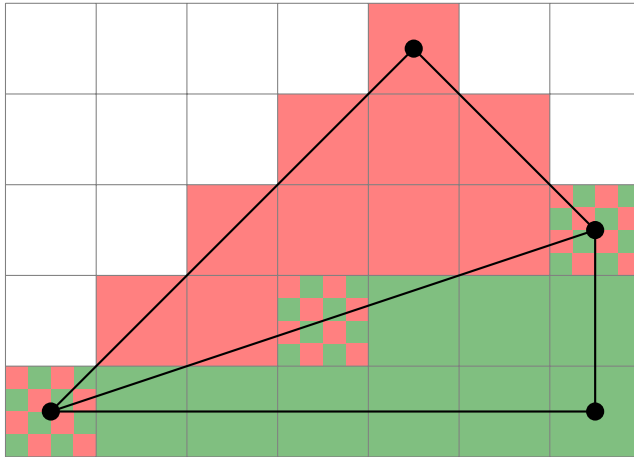


## Rasterizing adjacent triangles



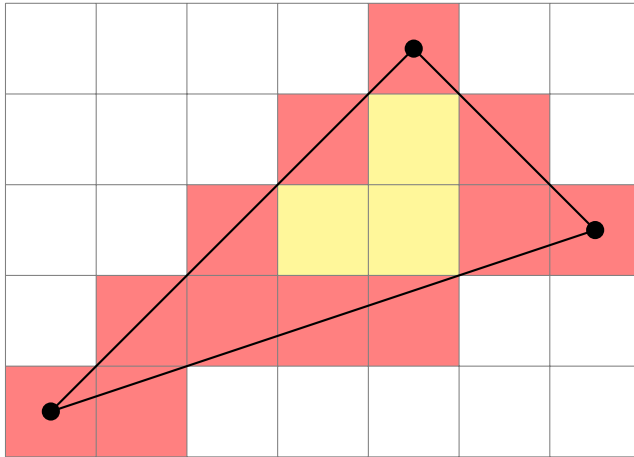
Who fills shared edges?

## Rasterizing adjacent triangles



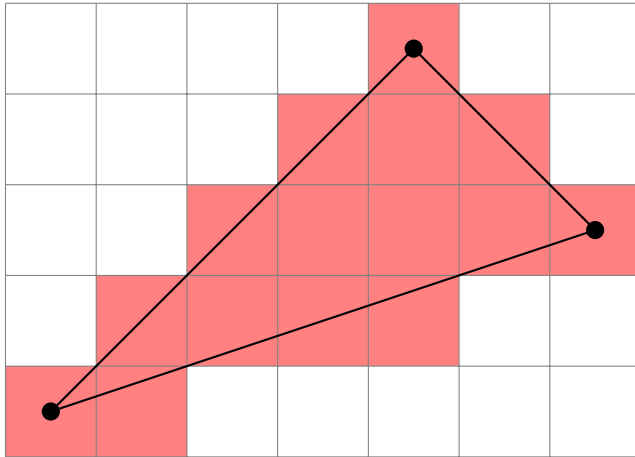
Who fills shared edges?

## Algorithm choices



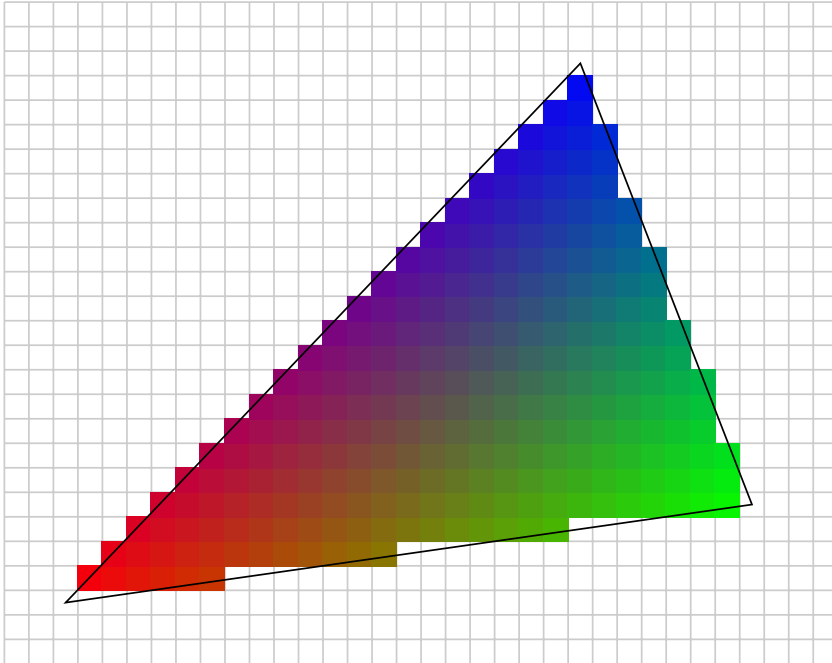
Midpoint algorithm for edges, then fill?

## Algorithm choices



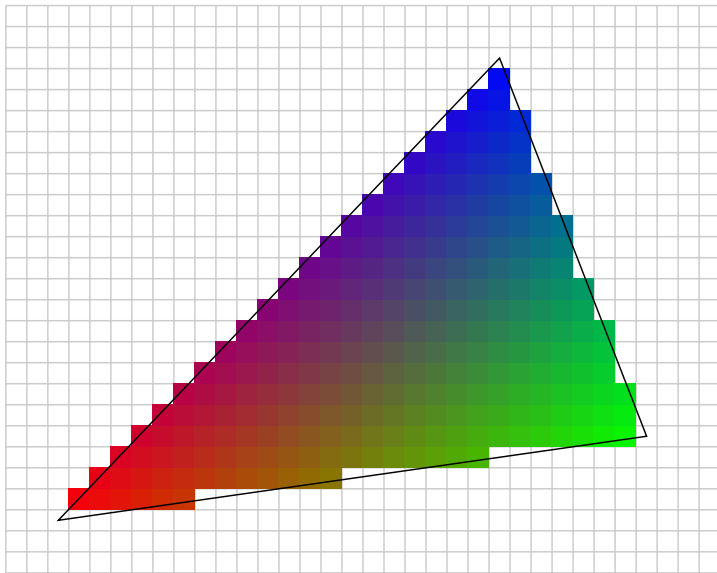
Use an approach based on inside/outside queries.

## Interpolate using barycentric coordinates



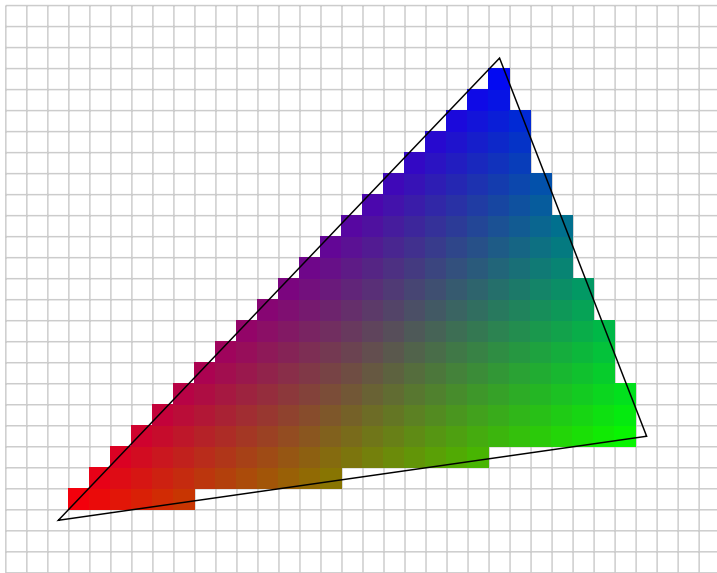
# Triangle rasterization algorithm

```
for all  $x$  do
  for all  $y$  do
    Compute  $(\alpha, \beta, \gamma)$  for  $(x, y)$ 
    if  $0 \leq \alpha, \beta, \gamma \leq 1$  then
       $c = \alpha c_0 + \beta c_1 + \gamma c_2$ 
      Draw pixel  $(x, y)$  with color  $c$ 
```



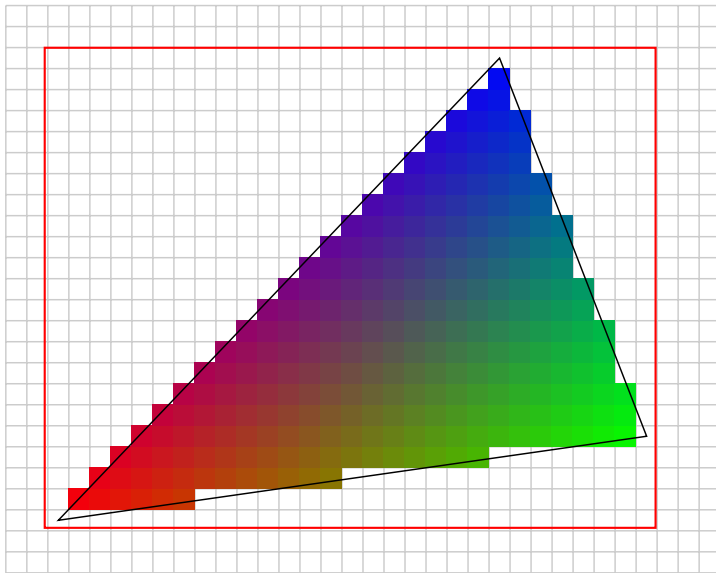
# Triangle rasterization algorithm

```
for all  $x$  do
  for all  $y$  do
    Compute  $(\alpha, \beta, \gamma)$  for  $(x, y)$ 
    if  $0 \leq \alpha, \beta, \gamma \leq 1$  then
       $c = \alpha c_0 + \beta c_1 + \gamma c_2$ 
      Draw pixel  $(x, y)$  with color  $c$ 
```



# Triangle rasterization algorithm

```
for all  $x \in [x_{min}, x_{max}]$  do
  for all  $y \in [y_{min}, y_{max}]$  do
    Compute  $(\alpha, \beta, \gamma)$  for  $(x, y)$ 
    if  $0 \leq \alpha, \beta, \gamma \leq 1$  then
       $c = \alpha c_0 + \beta c_1 + \gamma c_2$ 
      Draw pixel  $(x, y)$  with color  $c$ 
```



## Optimizations

- $0 \leq \alpha, \beta, \gamma$  implies  $\alpha, \beta, \gamma \leq 1$ 
  - only check  $0 \leq \alpha, \beta, \gamma$

# Optimizations

Observation:

$$\alpha = \frac{\text{area}(P, B, C)}{\text{area}(A, B, C)} = k_0 + k_1x + k_2y$$

$$k_0 = \frac{\text{area}(\mathbf{o}, B, C)}{\text{area}(A, B, C)} \quad \mathbf{o} = (0, 0)$$

$$k_0 + k_1 = \frac{\text{area}(\mathbf{e}_1, B, C)}{\text{area}(A, B, C)} \quad \mathbf{e}_1 = (1, 0)$$

$$k_0 + k_2 = \frac{\text{area}(\mathbf{e}_2, B, C)}{\text{area}(A, B, C)} \quad \mathbf{e}_2 = (0, 1)$$

# Optimizations

Quantities like this:  $\alpha = k_0 + k_1x + k_2y$

Can be updated like this:

$$x \leftarrow x + 1 \implies \alpha \leftarrow \alpha + k_1$$

$$y \leftarrow y + 1 \implies \alpha \leftarrow \alpha + k_2$$

Similar for  $\beta$  and  $\gamma$ .